Maastricht University

The effectiveness of the MaRBLe programme

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Chapter 13
The Effectiveness of the MaRBLe Programme: Evaluation Findings

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Abstract The roots of the Maastricht Research Based Learning (MaRBLe) programme at Maastricht University (UM) extend back to the Sirius programme, which is a large grant programme in the Netherlands. The Sirius programme required all institutions to present annual evaluation reports in which a wide range of themes are addressed, such as the number of students participating in the programme, general results and outcomes, and challenges the institutions were confronted with during the implementation and execution of the Sirius programme. This chapter provides an outline of UM's approach to establish sustainable evaluation methods for assessing the effectiveness of the MaRBLe programme. The evaluation was carried out on three general themes: the development of research skills, the structure of the programme and student grades. In addition to presenting the results of the quantitative analysis, this chapter addresses the challenges and limitations UM has encountered in carrying out sustainable evaluation cycles of the MaRBLe project over the course of five years.

Key words: course evaluations, grading, research-based learning, student evaluations, student questionnaires, undergraduate research

Introduction

The roots of the Maastricht Research Based Learning (MaRBLe) programme at Maastricht University (UM) extend back to the Sirius programme, which is a large grant programme in the Netherlands.[16] The Dutch Ministry of Education, Culture, and Science launched the Sirius programme with the aim to support institutions

[16] See www.siriusprogramma.nl

for higher education in their efforts to create new educational formats to challenge excellent students. MaRBLe, an honours programme aimed at training excellent students research skills within their discipline, was developed and funded by Sirius. It provides students the opportunity to conduct academic research under the supervision of academic staff. The Sirius programme required all institutions to present annual evaluation reports in which a wide range of themes are addressed, such as the number of students participating in the programme, general results and outcomes, and challenges the institutions were confronted with during the implementation and execution of the Sirius programme.

The evaluations were guided by three research questions in order to determine the effectiveness of the MaRBLe programme. The first question aimed at obtaining an understanding of the influence of various variables on the development of students' research skills in the MaRBLe programme. The variables of relevance to us were the social interaction with academic staff, and the extent to which students felt motivated and enjoyed conducting research on a topic of their interest.
The second research question focused in more detail on the structure of MaRBLe: Does a programme that is perceived by students as more structured, result in higher grades than a programme that provides students complete freedom to conduct research? This question was inspired by the fact that not all UM programmes offer enough space to experiment with new teaching concepts. Some programmes are composed of a (almost) completely compulsory curriculum due to a mandatory internship abroad, or due to national regulations on knowledge and competencies that must be addressed for the student to receive a diploma that qualifies them to practice their chosen profession. Due to these limitations, MaRBLe was developed in different models across the faculties, within the framework of general principles set out in Chapter 2.

The third research question focused on the comparison of grades between the bachelor's students participating in MaRBLe and those who did not. The underlying assumption is that MaRBLe students should obtain higher grades, because: (a) they are excellent students, and; (b) they receive more training in research skills and theories.

Method

Participants

The MaRBLe programme was developed for third-year bachelor's students who met the requirements for admission to excellence programmes. In our case, these

criteria entailed that students should have: (a) no study delay in the first two years of the bachelor's, and; (b) an average grade for the first two academic years of 7.5 or higher (on a scale from 1 to 10). The general approach to selecting students consisted of three steps:

1. We informed all students who met the requirements about the programme and about the opportunity to conduct their own academic research project.
2. If students wanted to join, they had to write a motivation letter explaining their interest in academic research.
3. The coordinator of the MaRBLe programme evaluated the motivation letters in close consultation with the students' future research supervisors.

In exceptional cases, students who did not meet the formal requirements were admitted to the programme based on their motivation letter. In these cases the faculty coordinators contacted the student's mentor to inquire about his or her motivation and research attitude.

The tutors involved in MaRBLe were academic staff members motivated to support and coach a group of young students in their first academic research project. The tutors ranged from third or fourth year PhD students who already had a well-appreciated track record in their own line of research, to highly esteemed researchers in their specific discipline. In total, students and staff from six UM faculties, spanning 16 different bachelor's programmes, participated in the MaRBLe project.

Materials

For the data collection we initially developed two evaluation questionnaires, one for students and one for staff. These questionnaires were paper-based and sent to students and staff by email. More recently, we transitioned to digital versions of the questionnaires, using the online tool NetQuestionnaire. During the five consecutive cycles of the programme, we learnt from our evaluation methods, and from 2011 onwards we implemented a baseline questionnaire for students.

The baseline questionnaire entailed student self-assessment on the level of competence in various research tasks in academic research, such as formulating a hypothesis or applying a research methodology. The research tasks we formulated were premised on the competencies outlined by Willison and O'Regan (2007). The evaluation questionnaires contained questions about the level of competence in academic research and questions on the organisation of the programme. The aims of the baseline questionnaire and the evaluation questionnaires were the same. Furthermore, open-ended questions were used to gain more in-depth insight into the quality and effectiveness of the programme. The necessary data regarding students' grades were attained from the faculties' student administration, and stored in one database.

Procedure

The baseline questionnaire was sent to students within two weeks after their admission to the programme. The student and staff evaluation questionnaires were sent no later than two weeks after students had finalised their research project. When necessary, a reminder was sent to students and staff approximately two weeks after the first request. The questionnaires were distributed by the coordinators of the programme in the participating faculties. Table 13.1 presents an overview of the types of questionnaires that were used. The numbers mentioned represent the number of questionnaires sent. As MaRBLe is embedded into the curriculum of all bachelor's programmes, the dropout rate is less than 1% per year.

Table 13.1 Overview of Questionnaires

	Type of questionnaire	2009	2010	2011	2012	2013
Student	Baseline	-	-	420*	270	324
	Evaluation	-	144	420*	270	324
Staff	Evaluation	-	65	90	75	85

*One of the bachelor's programmes transferred MaRBLe to another semester; therefore the number of students enrolled in 2011 is higher than the yearly intake of approximately 325 MaRBLe students based on the current situation.

This chapter's appendix presents a detailed overview of the variables and questionnaire items used to answer the research questions outlined in the Introduction. The first category of items related to the research competencies, enquiring about, for instance, the extent to which students felt competent in generating appropriate research questions and in organising research procedures. A second group of items related to support activities within the research projects. Such items queried as to whether the aim of the research topic had been clear, and about the organisation of the programme, including group meetings with other students and exchange of research with peers. A third group of items related to the overall grade and evaluation of the programme.

Results

Table 13.2 presents an overview of the variables that allow for inferential analysis based on means and standard deviations along with skewness, kurtosis, and Cronbach's alpha of scales.

Table 13.2 Overview of variables with statistical relevance

Scale #	Mean (SD)	Skewness	Kurtosis	Cronbach's alpha
Baseline: basic competence (range: 1-5)				
Questions and methods (3 items)	3.29 (0.75)	-0.32	-0.23	0.77
Analysis and communication (4 items)	3.43 (0.66)	-0.32	0.26	0.70
After programme: activities (range: 1-5)				
Interest in research (4 items)	4.30 (0.54)	-0.93	0.98	0.65
Meetings and project organisation (2 items)	3.78 (0.98)	-0.72	-0.05	0.76
Analysis and communication (3 items)	4.15 (0.68)	-1.07	3.26	0.81
Exchange of ideas with peers (2 items)	3.93 (0.90)	-0.85	0.58	0.84
Interaction with staff and institute (2 items)	3.12 (1.07)	-0.10	-0.65	0.77
After programme: evaluation (range: 1-10)				
Grade for project and tutor (2 items)	8.25 (1.05)	-1.23	3.25	0.79

N.B.: see appendix for an overview of each item per scale

Research Question 1: Variables of Influence

After appropriate correction for multiple testing, we found two interfaculty differences that were statistically significant, specifically on the *Questions and methods scale* (Baseline) and on the *Exchange of ideas with peers scale* (After programme). In both cases, students of one programme (School of Business and Economics) ($n = 62$ for the *Questions and methods* scale and $n = 24$ for the *Exchange of ideas with peers scale*) on average assigned slightly lower scores than students of other faculties.

With respect to gender, we found only one statistically significant correlation at the 0.05 level, specifically with the *Exchange of ideas with peers scale*, $r = 0.14$, $p = 0.037$. More precisely, female students gave slightly higher scores for the items on this scale than male students. Also, non-Dutch students gave significantly higher scores than their Dutch counterparts, not only on the *Exchange of ideas with peers scale* (After programme), $r = 0.18$, $p = 0.007$, but also on *Questions*

and methods (Baseline), $r = 0.19$, $p = 0.008$, and on *Analysis and communication* (Baseline), $r = 0.19$, $p = 0.008$. Furthermore, *Questions and methods* (Baseline) and *Analysis and communication* (Baseline) correlated quite well with each other ($r = 0.49$, $p < 0.001$).

The *Interaction with staff and institute scale* ($B = 0.14$, $SE = 0.045$, $t(182) = 3.16$, $p = 0.002$) and the *Interest in research scale* ($B = 0.48$, $SE = 0.079$, $t(182) = 6.10$, $p < 0.001$) together accounted for roughly 27% of the variance of *Analysis and communication* (After programme*)*. The standardised beta of 0.41 of the latter implied a large effect, whereas the standardised beta of 0.21 of the *Interaction with staff and institute scale* suggested a small- to medium-sized effect.

Research Question 2: Programme Structure

As faculty, gender, region, and baseline did not have strong effects, only *After programme scales* were used for further multiple regression modelling. All models (all predictors or just some) and data-driven selection procedures (backward, stepwise, forward, remove) resulted in the same two-predictor model. The scale that contributed the most to the prediction of grade was *Meetings and project organisation*, $B = 0.61$, $SE = 0.055$, $t(219) = 11.07$, $p < 0.001$, with its standardised beta of 0.57 suggesting a large effect (i.e., coefficients of 0.10, 0.25, and 0.40 implied small, medium, and large effects, respectively). Next in sequence was the *Interest in research scale*, $B = 0.53$, $SE = 0.100$, $t(219) = 5.31$, $p < 0.001$, with a standardised beta of 0.27 reflecting a medium-sized effect. Although these two scales exhibited some correlation ($r = 0.42$, $p < 0.001$), together they accounted for little more than 52% of the variance in grade.

Research Question 3: Grades

A comparison of grades between students participating in the programme and those who did not led to the results presented in Table 3. The analysis concentrated on the bachelor's grades. The columns show the mean grades students attained in four academic years. Due to administrative difficulties at various programmes we were not able to collect the necessary data for all programmes and academic years. The results unveil that, on average, MaRBLe students performed better than non-MaRBLe students. The deviation between the two student groups ranged from 0.2 points to 2 points, except for one instance where no difference was detected. Furthermore, the average grades of the regular students are an approximation, for most of them also include the grades of the MaRBLe students. If the ad-

ministration had made it possible to filter out the MaRBLe students, the average grades for the regular students would have been even lower.

Table 13.3 Study results of the students: bachelor's grades*

Cycle	2009-2010		2010-2011		2011 – 2012		2012-2013	
	MaRBLe-students	Regular students	MaRBLe-students	Regular students	MaRBLe-students	Regular students	MaRBLe-students	Regular students
1	8.7	6.5	8.2	7.4	8.2	6.8	8.3	7.3
2					7.6	7.8	8.1	7.4
3	7.9	7.6	8.6	8.2			7.6	7.1
4		8.1			8.2	8.0		
5	7.8		8.1	8.1			8.5	7.9
6							8.0	
7					8.4	7.1		7.4

* For most programmes the data on grades is integrated at faculty level

Discussion

In a recent review study, Linn et al. (2015) reviewed 60 studies on RBL experiences. They found that the majority of these studies merely based their results on self-report surveys, leaving ample room for a debate on the effectiveness of undergraduate research experiences and on what authentic research experiences should entail. For MaRBLe, the effectiveness of the projects was also measured by self-report surveys, distributed among the students.

The first research question addressed the influence of variables on students' learning results and grades. The results indicate that two scales, specifically *Interaction with staff and institute* and *Interest in research*, indeed correlate with the level of acquired skills. The second research question focused on the structure of MaRBLe. We found that the organisation of MaRBLe correlates with the students' grades. More specifically, the two scales revealing a correlation, that is, *Meetings and project organisation* and *Interest in research*, together accounted for just over 52% of the variance in grade. For two reasons we cannot draw any conclusions regarding the preferred delivery of MaRBLe: first, because the number of students per bachelor's programme was too limited; second, because not all faculties were included in all cohorts of the research. For example, it would not be possible to determine if a decreased student-to-staff ratio – fewer students per member of staff in each group – would occasion a rise in grades. The third and final research question concerned a comparison of the grades of students participating in the research

programme to those students who did not. Here, we found that MaRBLe students typically outperformed non-MaRBLe students.

Nevertheless, it should be emphasised that the conclusions of our effectiveness research are tentative, as a few limitations are in place. First, the method of data collection was fragmented throughout the programme. Not only did the method of data collection change, we also slightly altered the questions during the process due to ambiguities in earlier versions. An upside to these conditions was that the evaluation of the programme was a continuous process of learning and improving; the downside, however, was that some scales could not be used in the long run as the variables had been changed in between the separate rounds of evaluation. This brings us to a second limitation: The programme started every year with a new group of staff and students, and the cohorts were relatively small. Therefore, we cannot make any inferences for each cohort individually. By extension, the students filling out the baseline questionnaire in most cases were not the ones who filled out the evaluation questionnaire. In addition, to comply with the requirements of the Dutch Ministry for the annual evaluation reports, we made small alterations over the years, making it impossible to compare results on the performance of students between staff and students.

With regard to the comparison of grades between students participating in MaRBLe and those who did not, we have to make the following remarks. First, we did not correct our data for the possibility of students who completed MaRBLe performing better irrespective of participation because they were part of an excellence programme. Second, because of the lack of information on the standard deviation, we were not able to compute effect sizes.

The most important lesson we learned from this exercise with the dataset we had at our disposal is that we should have thought of evaluation methods that are sustainable in the long run at an earlier stage.

To conclude, the available data has provided us some insights into the effectiveness of the research-based learning programme at Maastricht University. Although the results must be interpreted with care, the main lesson learned is that the MaRBLe programme *has* been effective in training students in academic research.

Furthermore, proof for the effectiveness can be found in the growing influx of former MaRBLe students in renowned master's and PhD programmes at UM and other highly ranked universities around the globe. One of the challenges for the coming years is to invest in more rigorous research into the effectiveness of the MaRBLe programme, as advocated by Linn et al. (2015).

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Appendix

Items per scale, resulting from principal components analysis and supported by wording (and Cronbach's alpha)

Baseline: basic competence
Questions and methods (3 items)
At this moment, I feel competent in generating appropriate research questions
At this moment, I feel competent in setting up a design methodology to answer a research question
At this moment, I feel competent in organising a research process by appropriate procedures
Analysis and communication (4 items)
At this moment, I feel competent in analysing the data
At this moment, I feel competent in critically evaluating collected data
At this moment, I feel competent in estimating the consequences of new knowledge
At this moment, I feel competent in communicating research results to a broad range of audiences

After programme: activities
Interest in research (4 items)
In general, I have worked on the project with pleasure
I had sufficient basic skills to start the project
The aim of the project was clear to me
The topics in the project were interesting
Meetings and project organisation (2 items)
The group meetings were productive
The project was well organised
Analysis and communication (3 items)
Knowledge/skills I have mastered: write a research report
Knowledge/skills I have mastered: draw conclusions based on research
Knowledge/skills I have mastered: link conclusions to literature and/or practice
Exchange of ideas with peers (2 items)
I exchanged ideas about research with my fellow MaRBLe students
It was useful to exchange ideas about my research project with other students
Interaction with staff and institute (2 items)
During the project, I had ample opportunity to interact socially with researchers of the institute
I regularly discussed content matter within the community of academic staff

After programme: evaluation (range: 1-10)
Grade for project and tutor (2 items)

Rate the project on a scale from 1-10
Rate the supervisor on a scale from 1-10